Biological Evaluation:
City of Fayetteville Site-Specific Criteria Revisions for TDS, Chloride, and Sulfate in the White River, Arkansas

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Table of Contents

1.0 Background Information

1.1 Consultation History

On October 11, 2013, the City of Fayetteville initiated a 3rd party rulemaking to amend Regulation 2 establishing site specific minerals criteria specific to the Paul R. Noland Waste Water Treatment Plant discharge to a segment of the White River. On January 13, 2017, Fayetteville filed an Amended Petition based on recommendations by the Arkansas Department of Environmental Quality (ADEQ) and other public comments recommending that the criteria not be set any higher than necessary. The ADEQ recommended the proposed site-specific mineral criteria (chloride, sulfate and total dissolved solids (TDS)) applicable to the White River be divided into 2 segments to ensure that the criteria would reflect instream concentrations based on either the submitted data or the minerals concentrations based on monitoring data. The revised site-specific criteria were adopted by the Arkansas Pollution Control and Ecology Commission (APC&EC) on August 25, 2017. The ADEQ submitted these amendments to EPA for review by letter dated October 4, 2017.

The EPA defined the action area covered by Arkansas's water quality standard revisions in the USFWS's Environmental Online Conservation System - Information for Planning and Consultation (ECOS-IPaC) site and obtained a species list through IPaC on January 25, 2018. The EPA initiated informal consultation under Section 7(a)(2) of the Endangered Species Act (ESA) with the U.S. Fish and Wildlife Service (USFWS or Service) concerning the revisions to Arkansas' water quality standards through an initial March 7, 2018 letter to Melissa Lombardi, Endangered Species Biologist of USFWS Arkansas Ecological Services Field Office in Conway, AR. In that letter, EPA described the revised site-specific criteria that have been adopted by APC&EC and the threatened and endangered species identified through the Service's ECOS-IPaC system. The EPA requested any information the USFWS may have, including specific effects the revised mineral criteria may have on listed species within the defined action area

The USFWS responded by letter dated March 15, 2018. Melvin Tobin's letter provided EPA with comments on the mineral criteria adopted by the APC&EC. The letter confirmed that the following federally listed species that may occur in the project region: Rabbitsfoot *(Thelidenna cylindrica)*, Ozark Cavefish *(Troglichthys rosae)*, Piping Plover *(Charadrius melodus)*, Missouri Bladderpod *(Physariafiliformis)*, Gray Bat *(Myotis grisescens)*, Indiana Bat *(Myotis soda/is)*, Northern Long-eared Bat *(Myotis septentrionalis)*, and Ozark Big-eared Bat *(Corynorhinus townsendii ingens)*. The document noted that the Service does not anticipate an adverse effect to terrestrial listed species. As a result, the Service's comments focused on the Rabbitsfoot and Ozark Cavefish. The USFWS also noted that the Longnose Darter *(Percina nasuta)* which is petitioned for listing under the ESA also occurs in the affected reach of the White River.

1.2 Overview of Water Quality Standards and Criteria

A water quality standard defines the water quality goals for a waterbody by designating the use or uses to be made of the water, by setting criteria necessary to protect the uses, and by preventing or limiting degradation of water quality through antidegradation provisions. The Clean Water Act (CWA) provides the statutory basis for the water quality standards program and defines broad water quality goals. For example, Section 101(a) states, in part, that wherever attainable, waters achieve a level of quality that provides for the protection and propagation of fish, shellfish, and wildlife, and for recreation in and on the water ("fishable/swimmable").

Section 303(c) of the CWA requires that all states adopt water quality standards and that EPA review and approve these standards. In addition to adopting water quality standards, states are required to review and revise standards every 3 years. This public process, commonly referred to as the triennial review, allows for new technical and scientific data to be incorporated into the standards. The regulatory requirements governing water quality standards are established at 40 Code of Federal Regulations (CFR) Part 131. The minimum requirements that must be included in the state standards are designated uses, criteria to protect the uses, and an antidegradation policy to protect existing uses, high-quality waters, and waters designated as Outstanding National Resource Waters. In addition to these elements, the regulations allow for states to adopt discretionary policies such as allowances for mixing zones and variances from water quality standards. These policies are also subject to EPA review and approval.

Section 303(c)(2)(B) of the CWA requires the states to adopt numeric criteria for all toxic pollutants for which criteria have been published under Section 304(a). The EPA publishes criteria documents as guidance to states. States consider these criteria documents, along with the most recent scientific information, when adopting regulatory criteria. All standards officially adopted by each state are submitted to EPA for review and approval or disapproval. The EPA reviews the standards to determine whether the analyses performed are adequate and evaluates whether the designated uses are appropriate and the criteria are protective of those uses. The EPA makes a determination whether the standards meet the requirements of the CWA and EPA's water quality standards regulations. The EPA then formally notifies the state of these results. If EPA determines that any such revised or new water quality standard is not consistent with the applicable requirements of the CWA, EPA is required to specify the disapproved portions and the changes needed to meet the requirements. The state is then given an opportunity to make appropriate changes. If the state does not adopt the required changes, EPA must promulgate federal regulations to replace those disapproved portions.

Section 303(c) of the CWA requires states and authorized tribes to adopt water quality criteria that protect designated uses. States and authorized tribes have four options when adopting water quality criteria for which EPA has published nationally recommended criteria pursuant to Section 304(a) of the CWA. States may: (1) adopt nationally recommended criteria; (2) adopt nationally recommended criteria modified to reflect site-specific conditions; (3) adopt criteria derived using other scientifically defensible methods; or (4) establish narrative criteria where numeric criteria cannot be determined (40 CFR 131.11).

2.0 Federal Action

2.1 EPA Action on WQS Revisions

The federal action that is the subject of this biological evaluation (BE) is EPA's approval of adopted site-specific criteria (Table 1) adopted by the APC&EC for 5.65 river miles of the White River near the city of Fayetteville, Arkansas. These revised criteria were adopted by APC&EC August 25, 2017 and submitted for EPA review by letter dated October 4, 2017. The EPA has not acted on these amendments.

Table 1. Site-specific water quality criteria for the White River.

Stream Reach	Existing Criteria			Proposed Criteria		
	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	TDS (mg/L)
Noland WWTP to WR-02	20	20	160	44	79	362
WR-02 to Richland Creek	20	20	160	30	40	237

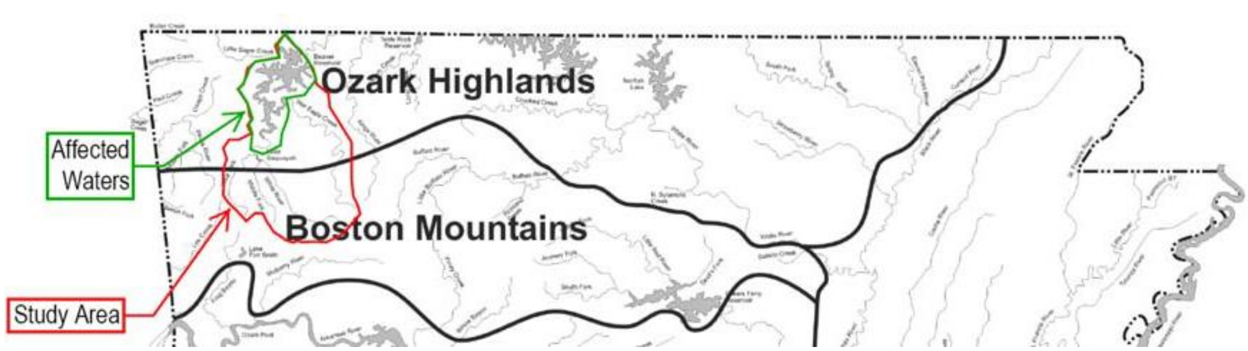
The state's supporting documentation for this rulemaking can be found at:
https://www.adeq.state.ar.us/regs/drafts/3rdParty/reg02/13-010-R/

The following analysis of the effects of the action assumes that listed species and their habitat are exposed to waters meeting the revised water quality standards. There may be waters in the state of Arkansas that currently do not meet the standards for chloride, sulfate and TDS. However, the only action under consideration at this time is whether the revised standards themselves and EPA's approval of them will have an effect on the species of interest.

2.2 Study Area

The study area that was considered by the City of Fayetteville during the rulemaking overlaps portions of the Boston Mountains and Ozark Highlands Ecoregions of Arkansas (Figure 1). The Ozark Highlands Ecoregion is characterized as relatively forested, mountainous, and having steep gradients and fast-flowing streams. Fractured limestone and dolomite geological features provide connections between surface and groundwater resources. The ecoregion has a relatively large percentage of streams designated as extraordinary resource waters, and karst features, such as caves, springs, and spring-fed streams are prevalent throughout. The Ozark Highlands have animal production rates which are among the highest in Arkansas. Impacts from increasing population growth and development, as well as instream gravel removal, have led to aquatic habitat destruction, surface erosion, and heavy siltation in streams (ADEQ, 2010).

Figure 1.
Level III Ecoregions of Arkansas (adapted from APCEC, 2011)



The specific study area is the Beaver Lake watershed, in the larger Upper White River watershed (Figure1). This includes the White River from its headwaters to Lake Sequoyah, the Middle Fork

White River from its headwaters to Lake Sequoyah, the West Fork White River from its headwaters to the White River, and Mill Creek (a tributary to the White River in the headwaters of the watershed). The White River flows to Beaver Lake, which was constructed by the U.S. Army Corps of Engineers (USACE) in the 1960s for purposes of flood control, hydropower generation, water supply, and fish and wildlife.

2.2 Physical, Chemical and Biological Conditions in the Study Area

The City of Fayetteville, Noland Waste Water Treatment Plant (WWTP) discharges to a 6.2-mile (mi) reach of the White River, which runs from Lake Sequoyah to Beaver Lake. APC&EC Regulation No. 2 specifies that primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and perennial Ozark Highlands fisheries designated uses apply to this portion of the White River (APC&EC, 2011).

Beaver Lake and Lake Sequoyah are designated as primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and lake fisheries. All portions of the study area in the Boston Mountains Ecoregion are designated as primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and perennial/seasonal Boston Mountain fisheries, with the exception of a portion of the White River, which is designated as an extraordinary resource water (APC&EC, 2011).

The main sources of non-point pollution in the Ozark Highlands ecoregion are agricultural practices, urban runoff, sewage sludge, and septic leachate (Graening & Brown, 2003; Graening & Brown, 2000; Niemiller et al., 2013). Select organic wastewater compounds have been found within cave streams in this ecoregion (Bidwell et al., 2010), but compounds including sulfate, chloride, and TDS were not considered threats to the ecosystem. Conversely, septic leachate and animal wastes have been implicated in polluting groundwater with sulfates and chlorides (Ogden, 1979). High levels of sulfate have also been linked to mining activities (Novinger, Stephens, & Beckman, 2012) but there is no activity currently in the action area.

Natural sources of sulfate in karst groundwater environments include the oxidation of sulfide and atmospheric acid deposition (Pu, Yuan, Zhang, & Zhao, 2013). Chloride in karst waters can be due to precipitation and carbonate rocks (Mustafa, Merkel, & Weise, 2015). The pollutants have the possibility of infiltrating into groundwater or continuing on to the White River. According to Aley, Aley, and Slay (2014), chloride is very mobile in water infiltrating into the karst groundwater system. However, there is very little data available on the effects of chloride, sulfate, and TDS to cave stream environments.

2.3 Exposure to Aquatic Life

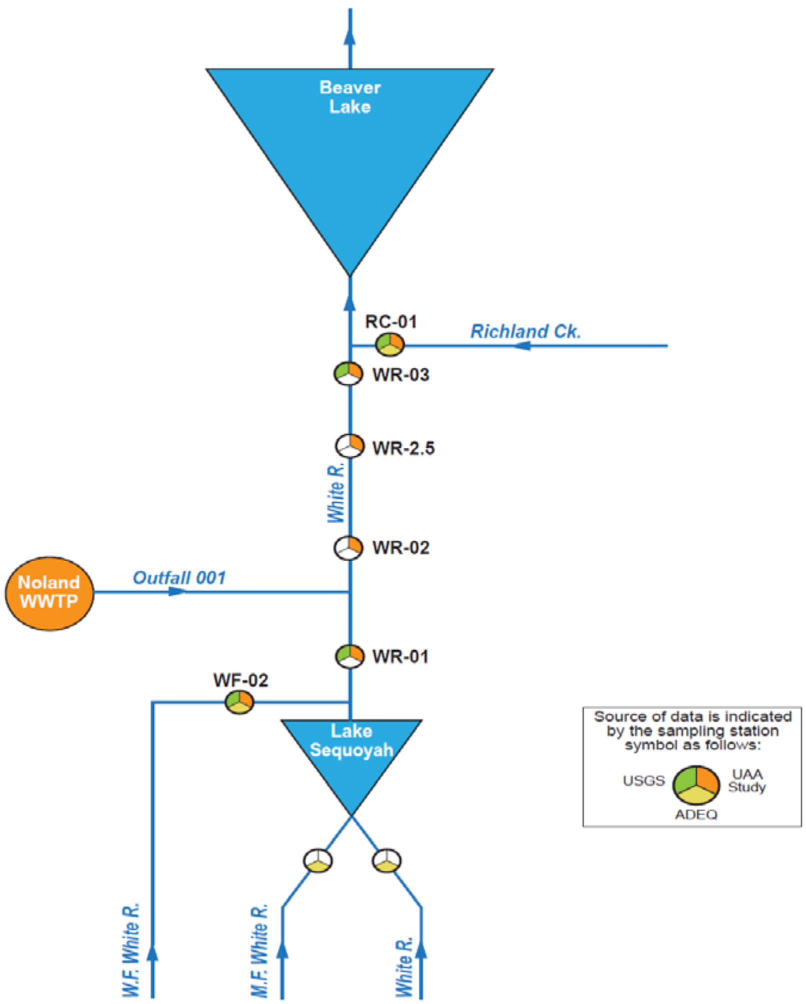
Chloride occurs naturally in both fresh and salt water bodies. But extremely high levels of chloride can interfere with osmoregulation in freshwater aquatic species, which can be problematic for survival, growth, and reproduction (Hunt, Herron, & Green, 2012). Additionally, fish are less sensitive to high chloride levels than planktonic crustaceans. The UAA Addendum (2015) concluded that revised criteria for White River are protective of aquatic life and chloride levels should not reach the point where they are harmful.

3.0 Effects Assessment

3.1 Action Area

The action area is defined as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR 402). The action is EPA's approval of Arkansas' site-specific water quality criteria for TDS, chloride, and sulfate for two segments of the White River within the Ozark Highlands Ecoregion of Arkansas.

Figure 3-1. Schematic diagram of waters in the action area:



The action area encompasses the entire 6.2-mile (mi) reach of the White River, from Lake Sequoyah to Beaver Lake has multiple designations described above, including perennial Ozark Highlands fishery. Beaver Lake and Lake Sequoyah also have multiple designated uses including lake fisheries. All portions of the study area in the Boston Mountains Ecoregion are designated perennial/seasonal Boston Mountain fisheries, with the exception of a portion of the White River, which is also designated as extraordinary resource waters (APCEC, 2011). This 6.2-mi segment of the White River was listed on the Arkansas then draft 2010 CWA Sec. 303(d) as not meeting its designated fishery use due to siltation/turbidity (category 4a) and is also listed chloride, sulfate and TDS exceedances; though specific designated use impairment is not identified. Upper Beaver Lake (i.e., the upper 1,500 acres of the reservoir) is included on Arkansas' draft 2010 303(d) List as not meeting its designated use of fisheries (formerly "aquatic life"), due to excessive siltation/turbidity. The source of impairment is cited as surface erosion (includes erosion from agriculture activities, construction activities, unpaved road surfaces, and in-stream erosion, mainly from unstable stream banks).

3.2 Species of Concern

The EPA requested and received current ESA species list through the USFWS's ECOS-IPaC system for the defined action area. This list, included as Appendix A, is specific to the species to be considered in this consultation. The list includes 8 species of interest that have been identified for consideration in this biological evaluation. Table 3-1 lists these species, their current status, and critical habitat listing for each species.

Table 3-1. Species listed under the ESA within the action area.

Mammals	**Status**	**Critical Habitat**
Gray Bat (*Myotis grisescens*)	Endangered	None designated
Indiana Bat (*Myotis sodalis*) Located outside critical habitat designated	Endangered	Critical designated
Northern Long-eared Bat (*Myotis septentrionalis*)	Threatened	None designated
Ozark Big-eared Bat (*Corynorhinus (=Plecotus) townsendii ingens*)	Endangered	Proposed
Crustaceans		
Ozark Cavefish (*Amblyopsis roase*)	Threatened	None designated
Clams/Mussels		
Rabbitsfoot (*Quadrula cylindrica cylindrical)* Located outside critical habitat designated	Threatened	Critical designated
Avian		
Piping Plover (*Charadrius melodus*) Population: wherever found	Threatened	Critical designated
Flowering Plants		
Missouri Bladderpod (*Physaria filiformis)*	Threatened	None designated

3.3 Species Characterization

In response to EPA's informal consultation request, the USFWS provided comments related to Arkansas's revised mineral (chloride, sulfate, and TDS) criteria. In those comments, the USFWS noted that it does not anticipate an adverse effect to terrestrial listed species (USFWS 2018). This includes the Missouri Bladderpod *(Physariafiliformis)*, Gray Bat *(Myotis grisescens)*, Indiana Bat *(Myotis soda/is)*, Northern Long-eared Bat *(Myotis septentrionalis)*, Ozark Big-eared Bat *(Corynorhinus townsendii ingens)* and the Piping Plover *(Charadrius melodus)*. The Service stated that it does not anticipate an adverse effect to terrestrial listed species from the revised mineral criteria. However, the Service indicated that consideration should be given to the Rabbitsfoot clam (*Quadrula cylindrica cylindrical)* and Ozark Cavefish (*Amblyopsis roase*) which will be discussed in more detail below.

3.3.1 Species Assessment and Determination

The EPA has made an assessment for all listed species identified through the Service's ECOS-IPaC site with ranges and/or critical habitat that overlap the defined action area to determine if exposure to the concentrations of chloride, sulfate, and TDS the state has adopted for two segments of the White River. The EPA has made these assessments and determinations considering the Service's (USFWS 2018) comments and other information in determining if its action is Likely to Adversely Affect (LAA), is Not Likely to Adversely Affect (NLAA), or would have No Effect on the listed species identified in Table 3-1.

The Missouri Bladderpod (*Physaria filiformis*) is a small annual plant with natural habitat in southern Missouri and northern Arkansas. The Bladderpod is only known from nine sites in three counties. The number of documented populations in 4 counties in Missouri and 2 sites in 2 counties in Arkansas. These sites are primarily open limestone glades; but the Bladderpod has been found on one dolomite glade in Arkansas. These natural glade habitats are threatened by residential development, overgrazing, and competition from encroaching woody and non-native grasses. As a wholly terrestrial species, EPA has determined that the revised water quality criteria for minerals will have no effect on the Missouri Bladderpod.

In determining the potential effect on the Gray Bat (*Myotis grisescens)*, Indiana Bat (*Myotis sodalis*), Northern Long-eared Bat (*Myotis septentrionalis)*, and the Ozark Big-eared Bat (*Corynorhinus (=Plecotus) townsendii ingens*), EPA considered the potential affect these criteria may have on the prey base of these species. The Ozark Big-eared Bat and Northern Long-eared Bat primarily forage on moths that are dependent on forest plants (Stark, 2008; USFWS, 2015). Although Gray Bats, Indiana Bats, and Northern Long-eared Bats are partially dependent on a variety of aquatic insects for their diets (Minnesota Department of Natural Resources, 2017; USFWS, 2006; USFWS, 2009; USFWS, 2015), the changes to chloride, sulfate and TDS criteria will not significantly impact aquatic-dependent species of insects (Johnson et al., 2014; Prommi & Payakka, 2015). Since the prey base of the Gray Bat, Indiana Bat, Northern Long-eared Bat, and the Ozark Big-eared Bat will not be significantly affected, EPA has determined that the revised minerals criteria is NLAA these species.

The Piping Plover (*Charadrius melodus*) are shorebirds that use rest sites along the migration pathway including shorelines of reservoirs/man-made lakes, ponds/fish farm ponds, marsh/wetlands, and alkaline and other natural lakes, and river shorelines within the defined action area. These stopover sites are highly influenced by local water levels, and tend to consist of locations with muddy/sandy substrates. Piping plovers feed on exposed beach surfaces by pecking for invertebrates that are 1/2 inch or less below the surface in wet substrates. Forage depends on the habitat available, the amount of prey, proximity of foraging areas to nest sites and the amount of human disturbance. Piping plovers do not concentrate in large numbers at inland stopover sites; instead, they stay for just a few days and then move on (USFWS 2015). The proposed alteration in mineral concentrations are unlikely to adversely affect the moderately to tolerant macroinvertebrates that make up a part the plover's prey base. Given this and the limited stopover time at these sites and limited effect of the increase in mineral concentrations are likely to have on the plover's prey base, EPA has determined that its action is NLAA the Piping Plover.

3.3.2 Rabbitsfoot mussel (Quadrula cylindrica cylindrical)

The rabbitsfoot (*Quadrula cylindrica cylindrical*) is a medium to large mussel, and primarily inhabits small to medium sized streams and some larger rivers. It usually occurs in shallow water areas along the bank and adjacent runs and shoals with reduced water velocity. It may also occupy deep water runs. Bottom substrates generally include gravel and sand (Parmalee and Bogan 1998). This species seldom burrows but lies on its side (Watters 1988; Fobian 2007).

Rabbitsfoot populations west of the Mississippi River reach sexual maturity between the ages of 4 to 6 years (Fobian 2007). The Rabbitsfoot is sedentary with seasonal movement towards shallower water during brooding period (May to late August), a strategy to increase host fish exposure. This strategy also leaves them more vulnerable to predation and fluctuating water levels, especially downstream of dams (Fobian 2007; Barnhart 2008, pers. comm.).

Adult rabbitsfoot mussels are filter feeders and generally orient themselves on or near the substrate surface to take in food and oxygen from the water column. Juveniles typically burrow completely beneath the substrate surface and are pedal (foot) feeders until the structures for filter feeding are more fully developed (Yeager et al. 1994, pp. 200-221; Gatenby et al. 1996, p. 604). The rabbitsfoot consumes algae, bacteria, detritus, and microscopic animals (Strayer et al. 2004, pp. 430-431). It also has been surmised that dissolved organic matter may be a significant source of nutrition (Strayer et al. 2004, p. 430).

The decline of the rabbitsfoot is primarily the result of habitat loss and degradation (Neves 1991, p.252). The EPA agrees with the Service's (2018) comments that said that although elevated ion concentrations can induce osmotic stress in freshwater organisms (Mulloch et al. 1993), the revised mineral criteria level that Arkansas has adopted does not rise to a level that affects survival and growth of freshwater mussels (Ciparis et al. 2015) or to the level of expected toxicity (Mount et al. 1997, Goodfellow et al. 2000, Soucek and Kennedy 2005). Rabbitsfoot is presently extant in 51 of the 141 streams of historical occurrence. Although the rabbitsfoot was identified as occurring within the defined action area through the ECOS-IPaC site, the Service noted in its comments (2018) that the rabbitsfoot is not known from this reach of the White River. Given that the rabbitsfoot is not known in the action area, EPA has determined that its action will have no effect on this species.

3.3.3 Ozark Cavefish (Amblyopsis roase)

Ozark cavefish are small fish reaching a maximum total length of about 75 mm (about 3 in). Cavefish lack pigment, and appear pinkish-white because their translucent skin. Cavefish eyes are vestigial and there is no remnant of the optic nerve in adults. In addition to vestigial eyes, they may be differentiated from non-cave fish by their lack of pelvic fins. The dorsal and anal fins are located further forward than other fishes, the caudal fin is rounded and has two to three rows of sensory pits (papillae) on the lower and upper halves. Ozark cavefish differ from other cavefish in the absence of a postcleithrum bone, and in the arrangement of cutaneous sense organs, and number of dorsal, anal, and caudal rays (Poulson, 1961; USFWS, 1989; Romero, 1998). Another distinguishing feature for the Ozark cavefish is that its lower jaw slightly protrudes and the head is flattened.

The specific breeding habits of Ozark cavefish are unknown, including the number of eggs produced and whether they mouth brood or not. Although the reproductive season has not been documented, Boyd (1997) located 10 mm young of the year cavefish in July in Logan Cave, and Kampwerth (pers. obs. 2005) observed similar sized young of the year in January in Cave Springs Cave. Cavefish diets include small crayfish, isopods, copepods, ostracods, larval salamanders, and young of their own (Poulson 1963).

The Ozark cavefish distribution is restricted to the Springfield plateau geologic province of Arkansas, Missouri, and Oklahoma. The Springfield plateau is drained by the White, Neosho, and Osage rivers. Ozark cavefish historically occurred at approximately 52 sites (Brown and Todd, 1987). Of these, 41 are considered active caves. Ozark cavefish are acknowledged as groundwater obligates, occurring in habitats (the Springfield Plateau Aquifer) within Boone and Burlington Formation limestones, especially in cave streams with chert rubble substrate, and occasionally in wells and sinkholes, and even in the soil phreatic zone (Poulson, 1961, 1963; USFWS, 1986). Woods and Inger (1957) suggest cavefish dispersal occurs through phreatic cave passages. Noltie and Wicks (2001) suggests that due to shale geologic confining units, Ozark cavefish are distributed in near surface and epikarst habitats. Count estimates of Ozark cavefish do not reflect actual numbers since they may only be accessible reaches of caves and wells and those in groundwater conduits are not accessible. Based on monitoring numbers and professional judgment of cavefish biologists for determining population trend, six populations have declined, 25 are undetermined, and 10 are stable. In its comments to EPA on the proposed action, the Service (2018) stated that although the Ozark cavefish is known from the watershed, there are no known occurrences near the affected stream reach have been documented.

In those same comments, the Service (2018) stated that the unique hydrology and the karst cave environments in which Ozark cavefish occur make the species highly vulnerable to groundwater pollution. The EPA agrees with the Service in that the characteristics of karst ecosystems make the underground environment relatively fragile and highly susceptible to disturbances. Although elevated ion concentrations can induce osmotic stress in freshwater organisms (Mulloch et al. 1993), the revised mineral criteria that are the subject of EPA’s action do not represent significant changes in concentrations and are not likely to adversely impact the Ozark cavefish. The greater threat to the Ozark cavefish would result in the destruction, modification or curtailment of it habitat or range. Threats from agriculture, particularly the loss of forest canopy conversion to pasture and animal production and urbanization/development are significant. Contamination of groundwater as a result of non-point source contamination is a significant threat where there are limited regulatory protections available under the Clean Water Act. In its comments, the Service also noted that there are no known hydrologic features that allow water in the affected stream reaches to reach occupied Ozark Cavefish sites. Given that there are no known documented occurrences of the Ozark cavefish near the stream segments within the action area and no known hydrologic features that allow water in these stream segments to reach occupied Ozark Cavefish sites, EPA has determined that its action is NLAA the Ozark cavefish.

4.0 Effects Determination

4.1 Final Effects Determination

EPA considered the available information in the literature and the technical comments from the Service, looking primarily at how increases in chloride, sulfate, and TDS would affect the listed species (Table 3-1) within the defined action area. There are no nationally recommended water quality acute/chronic criteria for aquatic life for sulfate and TDS, however, the revised criteria for chloride that Arkansas has adopted is well within the federally recommended limits.

The EPA has determined that the approval of site-specific criteria (Table 1) adopted by the APC&EC for 5.65 river miles of the White River near the city of Fayetteville, Arkansas will have no effect on Missouri Bladderpod (*Physaria filiformis*) and the Rabbitsfoot mussel (*Quadrula cylindrica cylindrical*). Further, we have determined that the approval of these site-specific criteria are NLAA the Gray Bat (*Myotis grisescens)*, Indiana Bat (*Myotis sodalis*), Northern Long-eared Bat (*Myotis septentrionalis),* Ozark Big-eared Bat (*Corynorhinus (=Plecotus) townsendii ingens*), Piping Plover (*Charadrius melodus*) and the Ozark Cavefish (*Amblyopsis roase*).

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